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THE WORK OF THE YUMA RECLAMATION PROJECT EXPERIMENT FARM IN 1915.[1]

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INTRODUCTION.

The experiments carried on at the Yuma Experiment Farm relate chiefly to the crops of local importance and those important to irrigated lands of the near-by projects along the lower Colorado River. Cultural and soil-improvement problems are studied from year to year. Varietal tests and some variety-improvement work looking to the development of locally adapted strains have been carried out.

Many of the experiments under way are a continuation of the work of former seasons. During the last three years 1,299 species, varieties, or strains of seeds and plants have been received and tested on the experiment farm. The behavior of many of these plants, failures as well as successes, has been discussed in former reports of this station. Many more are not yet sufficiently developed to furnish definite conclusions, while some are considered in this report. This paper covers the more important features of progress in the work of the year 1915 and touches briefly upon the agricultural developments of the Yuma project. The arrangement of fields and the location of experiments on the experiment farm are shown in figure 1.

[1] The Yuma Experiment Farm is located near Bard, Cal., on the Yuma Reclamation Project, 7 miles north of Yuma, Ariz. It consists of 160 acres of land, all of which is irrigable.

Various offices of the Bureau of Plant Industry have cooperated in conducting experiments during the year, as follows: The Office of Acclimatization and Adaptation of Crop Plants, in breeding and testing varieties of cotton and in growth studies of corn; the Office of Forage-Crop Investigations, in testing varieties of alfalfa and sorghum and in investigational work with other forage crops; the Office of Cereal Investigations, in flax experiments; the Office of Crop Physiology and Breeding Investigations, in breeding and variety tests with figs and dates; the Office of Foreign Seed and Plant Introduction, which has supplied various exotic species of fruits, ornamentals, and vegetables that have been tested; the Office of Alkali and Drought Resistant Plant Investigations, in breeding and varietal work with pomegranates; and the Biophysical Laboratory, in making meteorological observations.

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FARM IMPROVEMENTS.

The area of irrigable land on the experiment farm was increased during the year by the leveling of an additional 9 acres of rough land. Pasture for stock was afforded by fencing a 6½-acre block in two inclosures.

Two concrete inverted siphons were constructed on farm irrigation laterals, allowing the roads that cross these canals to be placed on a low grade. A small engine house, to inclose engines, pumps, and other small power-driven machinery, was built.

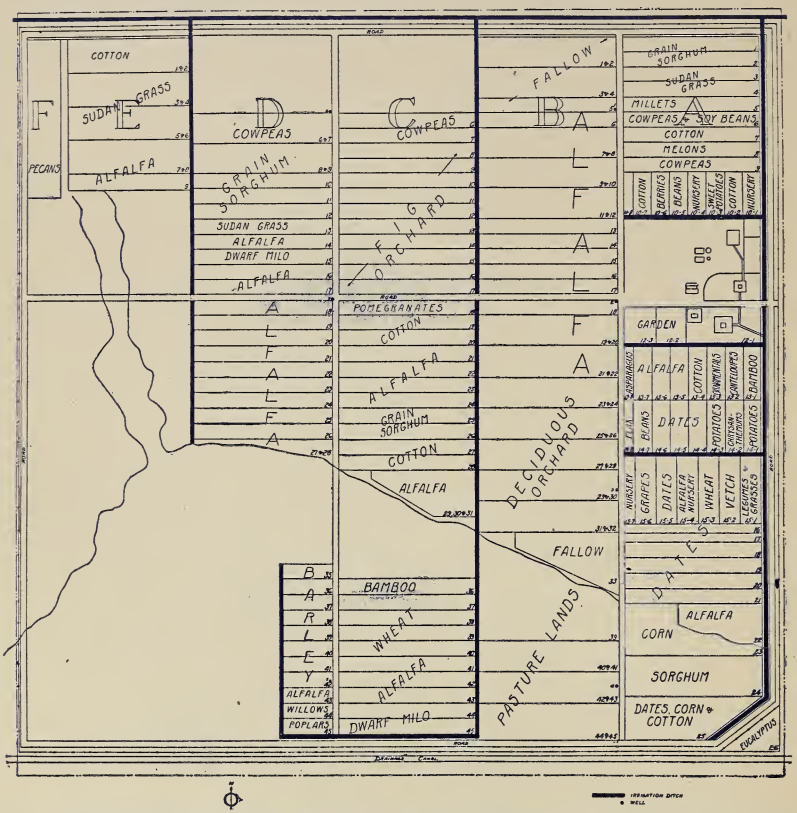

FIG. 1.—Diagram showing the arrangement of the fields and the location of the experiments at the Yuma Experiment Farm in 1915.

The accommodations for employees were improved by the construction of a small building for the occupancy of a mess club. The office building was slightly remodeled, to improve the ventilation and the lighting in a part of the building.

CONDITIONS ON THE PROJECT.

Climatic conditions.—The weather conditions during 1915 were, with few exceptions, very favorable to field crops. There occurred

on the night of May 1 a minimum temperature of 33° F., accompanied by a white frost, which injured beans, early melons, and early cotton. However, these crops were not killed, but only checked, which did not necessitate replanting. A very heavy windstorm on April 13 did considerable damage to crops, especially the heavy grains, which were badly lodged. Again, on August 15 a severe windstorm occurred. This swept only a narrow path, extending on both sides of the experiment farm, and traveled from southwest to northeast. Many large trees were uprooted and stacks of unthrashed alfalfa seed in the path of this storm were damaged by the wind and left exposed to the accompanying rain. Two rainless periods of 83 and 62 days, respectively, were experienced during the summer. The first killing frost in autumn, occurring November 13, was approximately two weeks earlier than usual. The precipitation for the entire year was approximately 2 inches heavier than normal. Evaporation and wind velocities deviated but little from the normal values. A summary of the climatological observations recorded during the 6-year period, 1910 to 1915, inclusive, is presented in Table I.

TABLE I.—*Summary of meteorological observations at the Yuma Experiment Farm, 1910 to 1915, inclusive.*

PRECIPITATION (INCHES).

Year, etc.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Averages for 6 years, 1910 to 1915, inclusive	0.498	0.0444	0.42	0.19	0.125	0.865	0.26	0.371	0.103	0.325	0.475	0.24	3.62
For 1915	2.21	.815	.12	.13	.....	.....	.08	1.33	.57	.....	.15	.24	5.645

EVAPORATION (INCHES).

Averages for 6 years, 1910 to 1915, inclusive	3.20	3.96	6.45	6.75	9.72	10.63	10.06	9.64	7.78	5.84	3.91	2.89	80.83
For 1915	2.487	2.747	5.33	7.358	9.14	10.44	10.25	8.818	6.415	5.486	4.084	2.822	75.377

AVERAGE DAILY WIND VELOCITY (MILES PER HOUR).

1910	.....	.....	.....	.....	4.1	3.8	3.6	3.4	2.4	3.7	3.3	3.5	.....
1911	3.0	3.5	2.7	3.8	3.3	2.9	2.5	2.0	1.7	2.5	3.7	3.5	.....
1912	3.2	4.0	3.9	3.8	3.3	2.6	2.3	2.1	3.1	3.0	2.9	4.0	.....
1913	3.1	3.3	4.1	3.1	2.4	2.1	2.1	2.1	2.0	1.9	1.8	2.1	.....
1914	2.8	3.4	3.0	3.3	2.4	2.3	1.9	2.2	1.7	1.6	1.05	1.75	.....
1915	2.3	2.2	2.2	2.9	3.3	2.2	2.2	1.4	1.3	1.2	2.4	2.3	.....

TEMPERATURE (°F.).[1]

Absolute maximum:													
6 years, 1910 to 1915, inclusive.	84	88	96	106.5	120	117	116	113.5	116	107	94	81	120
For 1915	72	75	90	95.5	103	109	108.5	113	108	100.5	93	80	113
Absolute minimum:													
6 years, 1910 to 1915, inclusive.	16	27	30	32	33	47	55	57	46	36	28	16	16
For 1915	27.5	32	31	44	33	51	56	60	46	40	29.5	23.5	23.5
Mean:													
6 years, 1910 to 1915, inclusive.	52.9	55.2	61.6	68	74.9	81.1	87	88.1	81.8	70.2	60.9	50.9	69.4
For 1915	51.7	55.2	60.9	66.2	69	80.6	85.8	87	78	70.9	59.4	52.4	68.1

[1] The records of maximum and minimum temperatures date from Apr. 21, 1910.

TABLE I.—*Summary of meteorological observations at the Yuma Experiment Farm, 1910 to 1915, inclusive*—Continued.

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		°F.		°F.	*Days.*
1910			Nov. 27	32	
1911	Feb. 24	32	Nov. 24	32	262
1912	Mar. 31	32	Dec. 4	31	247
1913	Mar. 28	32	Dec. 2	31	248
1914	Mar. 4	31	Dec. 4	32	275
1915	Mar. 3	31	Nov. 13	31	254

General development.—The total value of crops produced on the entire project for the year 1915, figured at current prices, exceeds the 1914 production by $164,318, or an increase of 23 per cent. This increase in value comes from a total area of 27,857 acres irrigated, or 2,650 acres more than was irrigated during 1914. This area is included in 737 farms. At the close of 1915, 72,440 acres on the project had irrigation water available, while only 38.5 per cent of this area was cropped and irrigated. Farm conditions on the project show definite progress in development and improved equipment, especially on farms longest under irrigation.

Crop conditions.—The yields of all important crops grown in 1915 were high when compared with the yields of previous years. The statistics of crop yields and values, as compiled by the local division of the Reclamation Service, show the yields of all crops except alfalfa hay to be higher than in 1914. The average yield per acre of alfalfa hay, according to these statistics, is undoubtedly misleading, as the established stands of alfalfa during the season produced very good yields. There are included in this acreage a great many fields of late-seeded, new plantings and a large area of seed-producing alfalfa, the low hay yields from which areas reduce the average of the yield per acre. From these same statistics it may be observed that the average value per unit of yield of all crops considered except grain sorghums and corn was higher than that estimated for the 1914 crop. Grain sorghums brought only slightly lower prices, and corn is of such small relative importance in the agriculture of this section as to be almost negligible.

The average farm value per acre was estimated at $34.81 in 1915, as compared with $31.43 the previous year. The acreage, yields, and farm values of the crops grown on the project in 1915 are shown in Table II, these figures being obtained from the Reclamation Service.

TABLE II.—*Acreage, yields, and farm values of the crops grown on the Yuma Reclamation Project in 1915.*

Crop.	Area.	Unit of yield.	Yield.			Farm value.		
			Total.	Per acre.		Per unit of yield.	Total.	Per acre, average.
				Average.	Maximum.			
	Acres.							
Alfalfa hay	9,441	Ton	24,227	2.57	9	$7.15	$173,297	$18.36
Other hay	774	do	1,110	1.44	2	8.95	9,937	12.07
Alfalfa seed	6,449	Pound	1,669,020	258.6	900	.1475	249,331	38.66
Barley	1,572	Bushel	47,951	30.5	50	.66	31,924	20.31
Wheat	2,267	do	40,231	17.75	35	.83	33,211	14.65
Grain sorghums	6,408	do	231,185	36.07	70	.63	144,892	22.61
Corn	262	do	5,900	22.52	40	.64	3,786	14.45
Cane and corn fodder	480	Ton	1,282	2.67	5	5.20	6,673	13.90
Cotton	709	Pound	359,850	507.6	1,000	.109	39,271	55.39
Cottonseed	709	Ton	335.83	.474	1	12.00	4,395	6.20
Beans	324	Bushel	1,830	5.65	15	2.99	5,471	16.89
Truck	387	Acre					30,197	78.01
Fruit	65	do					6,275	96.54
Pasture	7,899	do					95,361	12.07
Additional revenue [1]							39,700	
Less duplications	12,643							
Total	25,101						873,721	
Average								34.81

[1] From pasturing alfalfa, thrashed straw, and stalk lands in winter.

Table III shows the annual acreage, production, and farm values of the principal crops from 1911 to 1915, inclusive, according to data obtained from the Reclamation Service.

Among the field crops cotton shows the highest average return per acre, with alfalfa seed second. Good prices were received for both of these products, but the average acre returns for cotton might have been appreciably higher if Durango, a long-staple cotton, had been universally grown rather than the short-staple varieties. The area devoted to alfalfa-seed production was increased over that of 1914 by nearly 1,000 acres, with a slightly increased yield per acre. Unlike most seasons, there were harvested during 1915 many good, late seed crops. Two seed crops were taken from some fields.

While 74 per cent of the acreage of small grains grown in 1914 was barley, the total area in these crops was increased by 73 per cent in 1915. Of the 1915 acreage 59 per cent was in wheat. Wheat and barley are the only small grains now being grown in any quantity. The area pastured in 1915 was only slightly increased over that of 1914.

The 1915 census, taken in November, shows a gain of 8,808 head of live stock over that of a year ago, not including poultry. The number of horses, dairy cows, and beef cattle indicates only a normal increase over the past year's census. Hogs, however, are being produced in much larger numbers, a gain of 151 per cent being shown by the last annual census. Several hundred head of hogs of pure breed were brought into the project during the year.

TABLE III.—*Acreage, production, and farm values of the principal crops grown on the Yuma Reclamation Project in the years 1911 to 1915, inclusive.*

Item and year.	All crops.	Alfalfa hay.	Alfalfa seed.	Grain sorghums.	Wheat and barley.	Cotton.
Acreage:						
1911	8,570	3,750	[1] 2,600	420	1,290	30
1912	4,060	7,269	2,824	986	1,567	25
1913	16,726	10,321	3,388	2,928	1,585	62
1914	22,568	10,426	5,485	3,066	2,223	2,268
1915	25,101	9,441	6,449	6,408	3,839	709
Production:		*Tons.*	*Pounds.*	*Bushels.*	*Bushels.*	*Pounds.*
1911		16,327	576,730	13,106	39,083	15,000
1912		27,078	814,186	31,372	55,375	5,800
1913		38,100	1,139,100	112,597	45,075	19,610
1914		32,525	1,246,318	100,153	61,674	845,044
1915		24,227	1,669,020	231,185	88,182	359,850
Average yield per acre:						
1911		4.36	222	31.5	30.6	500
1912		3.73	288	31.8	35.3	232
1913		3.69	336	38.5	28.4	316
1914		3.12	227	32.6	27.8	373
1915		2.57	258.6	36.1	22.9	507.6
Farm value per unit of yield:						
1911		$15.00	$0.16	$0.854	$0.66	0.20
1912		10.00	.10	.75	.75	.20
1913		7.53	.111	.513	.668	.21
1914		6.05	.13	.70	.676	.08
1915		7.15	.1475	.63	.739	.109
Farm value per acre:						
1911	$51.80	65.44	35.52	23.62	20.20	100
1912	44.94	37.30	28.80	23.85	26.47	46.40
1913	36.48	27.83	37.33	19.72	18.95	66.50
1914	31.43	18.86	29.15	23.13	21.13	30.80
1915	34.81	18.36	38.66	22.61	16.97	55.39
Total farm value:						
1911	443,984.00	244,905.00	92,276.00	11,180.00	25,775.00	3,000.00
1912	497,012.85	270,780.00	81,418.60	23,529.00	41,517.00	1,160.00
1913	610,228.00	287,195.00	126,450.00	57,740.00	30,131.00	4,123.00
1914	709,409.00	196,716.00	159,806.00	70,915.00	41,373.00	78,399.00
1915	873,721.00	173,297.00	249,331.00	144,892.00	65,135.06	39,271.00

[1] This area is included in the alfalfa hay acreage for 1911.

At the date of the 1915 inventory there was a marked increase in the number of poultry over that of the previous year. This increase was more than 15,000 fowls. The production of turkeys has been noticeably increased. The number of ostriches has decreased somewhat, and the value of these birds is still very much depressed. There was a falling off in the number of sheep and of colonies of bees.

The total number of live stock on hand at the close of each year and their relative value, as ascertained by the Reclamation Service, for the years 1911 to 1915, inclusive, are shown in Table IV.

TABLE IV.—*Inventory of live stock on hand on the Yuma Reclamation Project at the close of each year and values for the years 1911 to 1915, inclusive.*

NUMBER.

Live stock.	1911	1912	1913	1914	1915
Horses	1,570	1,705	2,111	2,465	2,898
Mules	362	440	560	544	612
Beef cattle [1]	967	1,197	3,900	2,851	3,446
Dairy cattle	.....	.....	.....	2,043	2,249
Sheep	.....	.....	.....	1,384	1,251
Hogs	1,767	2,634	2,886	4,982	12,500
Ostriches	40	121	184	193	121
Fowls	22,857	25,646	27,882	35,935	50,723
Bee colonies	2,437	2,540	2,656	4,066	2,478
Total	30,009	34,283	40,179	54,463	76,278

TABLE IV.—*Inventory of live stock on hand on the Yuma Reclamation Project at the close of each year and values for the years 1911 to 1915, inclusive*—Continued.

AVERAGE VALUE PER HEAD.

Live stock.	1911	1912	1913	1914	1915
Horses	$106.00	$107.52	$105.00	$99.48	$90.20
Mules	128.00	127.33	150.00	138.37	126.86
Beef cattle [1]	51.40	49.52	58.00	37.68	44.66
Dairy cattle				81.42	73.02
Sheep				4.65	4.69
Hogs	7.15	9.07	8.65	7.60	6.49
Ostriches	315.00	186.95	145.00	5.57	5.83
Fowls	.64	.65	.62	.79	.65
Bee colonies	3.15	3.21	4.00	4.80	4.84

TOTAL VALUE.

Horses	$166,389	$183,364	$221,525	$245,227	$261,410
Mules	46,340	56,030	84,329	75,272	77,640
Beef cattle [1]	49,705	59,270	224,251	107,434	153,906
Dairy cattle				166,335	164,235
Sheep				6,432	5,868
Hogs	12,627	23,903	24,965	37,848	81,122
Ostriches	12,600	22,625	26,610	1,075	705
Fowls	14,559	16,578	17,180	28,342	32,936
Bee colonies	7,674	8,159	10,832	19,499	12,002
Total	309,934	369,929	609,692	687,484	789,824

[1] Beef and dairy cattle for 1911, 1912, and 1913 were not segregated.

Weed pests.—With the production of alfalfa seed, the principal money crop on the project, much attention has been given to the maintenance of fields free from noxious weeds, and more particularly those weeds having seed that is difficult to separate from alfalfa seed. The two most serious weed pests now present on the Yuma project are Johnson grass (*Andropogon halepensis*) and sour clover (*Medicago indica*). During the last two years the Reclamation Service has done much in controlling and eradicating Johnson grass along the irrigation canals, but much still remains to be done, and the active cooperation of the farmers is needed to control this weed. Sour clover abounds throughout the project and must necessarily be combated vigorously in order to keep free from contamination fields producing alfalfa seed. It is extremely difficult to separate sour-clover seed from alfalfa seed. The rapidity with which this weed spreads and produces seed increases the difficulty of its eradication. Its yellow flower, however, gives warning of its presence, should it have escaped unnoticed until flowering begins.

Probably Bermuda grass, the only other serious weed now abounding on the Yuma project, is as troublesome as the two mentioned. While valuable as a soil binder on ditch banks and as a forage plant in pastures, it is a serious pest in cultivated fields and alfalfa meadows. It is a plant that possibly may never be eradicated from this section, but must be controlled. Methods for the control of Bermuda grass were discussed in the report of this station for the year 1912.

Insect pests.—Insect pests were less injurious in 1915 than for several seasons past. Barley and wheat suffered comparatively little injury from the spring grain aphis (*Toxoptera graminum*). Cotton was practically free from aphids or plant-lice throughout the year, which is in marked contrast to the condition of the cotton of the preceding year. This same insect (*Aphis gossypii*), which often feeds on the tender parts of the cotton plant, frequently attacks melon and cucumber vines in midsummer in great numbers and generally kills the vines, but during 1915 the early melons grew through the entire season with little injury. The alfalfa caterpillar (*Eurymus eurytheme*), which has often ravaged large areas of alfalfa during the summer months through this section of southern California and Arizona, was not a serious pest during the past season.

CROP EXPERIMENTS.

Much of the investigational work conducted with cotton was a continuation of the experiments inaugurated previously and carried on in cooperation with the Office of Acclimatization and Adaptation of Crop Plants.

COTTON.

Durango cotton is the variety used in all cultural experiments, many of which were a continuation of the previous season's work. Of all experiments thus far conducted with this variety it seems definitely established that the best date for planting is during the first three weeks of April, although a yield of 1 bale per acre was secured from a planting made as late as May 29. After this date the yields gradually declined to one-third of a bale per acre from the latest planting, made July 8. Perhaps this is the answer to the question, so often heard in the lower Colorado River region, as to the latest practicable date for planting Durango cotton. This is, of course, a pertinent question when small grain, harvested late, is to be followed by cotton. A good profit from Durango cotton may be expected when normal prices are received and yields of a bale an acre are secured. Yields of more than a bale per acre may be expected as a reward of careful culture, and net profits increase rapidly with the higher yields.

The results of experiments concerning the relation of thinning distance to yield and the influence of the frequency of irrigations upon yields corroborate the conclusions drawn from similar experiments reported in 1914 that, in general, any check in growth occasioned by drought after the heavy setting of fruit begins, no matter of how short duration, is directly reflected both in the yields and in the quality of the fiber. From irrigation methods in practice in cotton culture, losses consistently occur, which, if avoided, would net

the grower an additional yield of at least one-fifth of a bale per acre. The objectionable features of these methods are sometimes difficult to overcome in actual practice. The injury consists of damage to stands by an incrusted soil, resulting from an early irrigation in an effort to germinate seed that was planted in soil already too dry; by flooding young cotton; and either by irrigating in the fall when the lower bolls are destroyed by wetting or by omitting this late irrigation, which on the lighter soils is likely to reduce the yield by curtailing the top crop.

ALFALFA.

Spring plantings were made in a variety test of a number of different foreign introductions of alfalfa, as follows: Algeria, 2; Arabia, 5; Argentina, 4; Chile, 2; Ecuador, 1; France, 4; India, 18; Italy, 3; Mexico, 2; Morocco, 1; Peru, 2; and Russia, 2. The comparative value of these varieties can not be determined for at least another season. An experiment conducted and reported for 1914 in harvesting alfalfa at different stages of growth, to determine the effect on the following crop, was repeated during 1915 with verifying results. Four commercial varieties of alfalfa seeded in the spring and grown under similar conditions in duplicate plats produced yields the first season as shown in Table V.

TABLE V.—*Yields of alfalfa varieties grown on the Yuma Experiment Farm in 1915.*

Variety.	Yield per acre (tons).		Percentage of water lost from field-cured samples.	Variety.	Yield per acre (tons).		Percentage of water lost from field-cured samples.
	Field cured.	Air dry.			Field cured.	Air dry.	
Peruvian	2.42	2.33	3.7	Arabian	1.96	1.78	9.2
Chilean (common)	2.42	2.28	5.8	Grimm	1.32	1.26	4.6

First-year yields are scarcely indicative of the comparative value of an alfalfa variety, but it is worth while to note that the Peruvian variety in this test produced the largest yield of air-dry hay and lost less water from field-cured hay than any of the other varieties.

Alfalfa seed.—As there are varying ideas among local growers as to what practice is best to follow for producing maximum yields of alfalfa seed, a few different treatments of seed plats have been compared. A field, the first crop from which was harvested for hay and the second crop retained for seed, was compared with another which produced a seed crop after being pastured throughout the winter and until late in the spring. The seed crops from both these fields were mature and harvested at the same date. In the yields, however, there was not shown the advantage in favor of winter pasturing which is quite generally believed to follow such treatment.

The differences in yield were so small as to be unimportant, but were slightly in favor of the unpastured field.

The practice of tripping alfalfa when in flower is not generally attempted in this locality. To try out this practice under local conditions a tripping test was conducted. An improvised tripper was made in the form of a light board float, easily held up by the alfalfa plants. This was dragged over the field when the plants were about 80 per cent in blossom. The tripping of the flowers seemed to be increased when compared with that portion of the field untreated, but the seed yields were not correspondingly increased. It must be realized, however, that many seemingly uncontrollable factors apparently influence the setting of alfalfa seed, and a single season's results are not generally sufficient to furnish final conclusions regarding any particular cropping method.

In cooperation with the Bureau of Entomology of the United States Department of Agriculture, periodic examinations were made of alfalfa seed pods collected from the field, to determine the extent of infestation of the chalcis fly, with the results shown in Table VI.

TABLE VI.—*Chalcis-fly infestation of alfalfa seed pods collected on the Yuma Experiment Farm, 1915.*

Date collected.	Percentage of infestation.	Date collected.	Percentage of infestation.	Date collected.	Percentage of infestation.	Date collected.	Percentage of infestation.
Apr. 24	39.2	May 28	21.0	June 23	26.6	Sept. 7	50.2
May 7	52.6	June 8	32.3	July 2	25.3	Sept. 14	49.3
May 12	36.1	June 11	29.5	July 28	54.5	Sept. 28	71.0
May 20	23.6	June 17	26.5	Aug. 4	21.7	Oct. 12	86.67

Doubtless all alfalfa-seed growers are familiar with the injury of this insect and the enormous damage sometimes suffered in the seed crop. The high percentage of infestation during the early dates does not necessarily indicate the presence of a larger number of the insects, but may be due to the smaller number of seed pods for the insects to feed upon. As the season advances the insect multiplies, but there are then also many more alfalfa seed pods to be infested. Late in the season, however, the chalcis fly is present in large numbers, and often late seed crops are a complete failure because of the ravages of this insect.

GRAIN SORGHUMS.

The grain-sorghum experiments of 1914 were repeated this season, and in addition a large variety test was conducted. A trial was also made of a number of varieties grown from the stumps of the previous year's plants. Alternate stubble rows of each variety were covered with one furrow of earth in the fall as a protection

against low temperatures. In the early spring these rows were uncovered and leveled with a light float. The lowest temperature experienced was 25° F. above zero, which was not sufficiently severe to injure the roots even in the unprotected rows. When growth began in the spring the unprotected plants showed a mortality of about 10 per cent, while of all varieties protected approximately 40 per cent had died. This difference was probably due to the decomposition of the stems of the covered stubble, as the winter rainfall was heavier than usual. There was practically no difference in the behavior of varieties. All were early and made a vigorous growth, but too many stalks were produced by each plant. The heads were small and ripened unevenly. As with all early-ripening sorghums, bird injury was serious.

Of 374 strains and varieties of grain sorghums tested none were found superior to the best varieties now being grown. The yields of nine of the standard grain-sorghum varieties grown for three successive years are recorded in Table VII.

TABLE VII.— *Yields of standard grain-sorghum varieties grown at the Yuma Experiment Farm, 1913 to 1915, inclusive.*

Variety.	Yield of air-dry grain per acre (bushels).												
	May planting.			June planting.			July planting.			Average.			Grand average.
	1913	1914	1915[1]	1913	1914	1915	1913	1914	1915	May.	June.	July.	
Dwarf milo	41.2	47.3	8.9	36.8	26.6	30.2	25.2	31.5	26.2	32.5	31.2	30.9	31.5
Feterita	37.4	42.2	4.8	32.4	24.9	44.6	18.2	19.7	29.8	28.1	34.0	22.6	28.2
Dwarf Blackhull kafir	24.0	16.9	4.3	20.8	10.7	23.35	15.6	22.5	28.0	15.1	18.3	22.0	18.5
Blackhull kafir	21.3	11.3	11.3	30.3	24.5	29.3	16.3	12.3	30.6	14.6	23.0	19.7	19.1
Shallu	26.9	18.7	10.6	18.1	43.7	26.2	15.2	31.8	54.4	18.7	29.3	33.8	27.3
Brown kaoliang	21.0	22.0	5.6	31.4	25.6	17.9	13.3	14.6	21.2	16.2	24.9	16.4	19.2
Red kafir	35.3	8.5	5.9	30.5	15.8	.....	11.8	26.2	.....	16.6	23.2	19.0	19.6
White kafir	.....	6.5	5.0	.....	15.9	18.7	.....	18.4	25.7	5.8	17.3	22.1	15.1
White milo	.....	54.9	5.8	.....	40.0	24.3	.....	30.7	37.1	30.4	32.2	33.9	32.2

[1] April.

This station has found no sorghum varieties that are more dependable and better adapted to local conditions than the first seven listed in Table VII. Dwarf milo and feterita are most valuable as feed for live stock. Shallu, Blackhull kafir, and Dwarf Blackhull kafir are excellent for poultry feed, while they are valuable as well for live stock. Red kafir is perhaps the best variety when both forage and grain are desired or for silage. If an especially short season crop is desired, brown kaoliang will succeed well. Some strains of white milo produce heavy grain yields, but it is difficult for a grower to know that he is securing a productive strain from seed houses, as there are some commercial strains of white milo which do not succeed in this region.

SUDAN GRASS.

Cultural experiments with Sudan grass conducted in 1914 and briefly discussed in the report of that year were duplicated during 1915, with verifying results of nearly all yields. It is in the regions of limited moisture supply that the greatest value has been attached to Sudan grass as a hay plant. Its value as an irrigated hay crop is not so important in this region, because it must compete with alfalfa and be compared with the vigorous and splendid hay-producing qualities of that plant. It can, however, be used to fill an important place in the general scheme of alfalfa production where the stand of alfalfa has become poor or where a mixed hay is desired. If Sudan grass is seeded during early April in an alfalfa field, it will be found that the next following crop of hay will be chiefly alfalfa, while the later hay crops, until late fall, will be a desirable mixture of alfalfa and Sudan grass. The last crop in the late fall is generally all alfalfa, as Sudan grass, like sorghums, is of very slow growth during cool weather. During the summer months, however, the growth of the two plants requires about the same period of time for developing a hay crop, and their irrigation requirements are similar.

This grass when handled correctly also responds very satisfactorily to pasturing. An area seeded to Sudan grass was pastured with milch cows and horses for six months during 1915, averaging a carrying capacity on the entire pasture of a little more than three head per acre. All the stock was kept in excellent condition and ate the grass readily. The pasture was divided and the stock alternated from one half to the other about every two or three weeks, or as often as irrigation was required. Each pasture was watered as soon as the stock was removed and left unpastured until the soil was firm and the grass had gained a growth of 4 or 5 inches.

MISCELLANEOUS FORAGE CROPS.

Forage Sorghums.

In cooperation with the Office of Forage-Crop Investigations an extensive collection of forage sorghums was planted, in order to study their development in a long-season climate and ascertain their relative values as forage producers. Of 241 varieties grown, the following were found to be very good and the best of the list for this climate: Planters' Friend, Sumac, Gooseneck, Kansas Straightneck, Black Amber, Red Amber, Honey, and Orange.

Millets.

Varieties of millet were tested both for hay and for seed production. The following commonly known varieties were grown under rather adverse conditions, producing air-dry hay yields, recorded in tons per acre, as follows: Goldmine, 3.26; Japanese, 2.71; Turkestan, 2.46;

and German, 1.57. In 1914 German millet produced 2.1 tons per acre. Along with the above-mentioned varieties, a number of selections of Ragi, Foxtail, and Pearl millets were also grown for seed production. These plantings were made in rows 3½ feet apart. The best yielding selections are shown in Table VIII.

TABLE VIII.—*Seed yields of varieties of millet at the Yuma Experiment Farm, 1915.*

Variety.	Stand.	Yield per acre.	Variety.	Stand.	Yield per acre.
	Per cent.	*Pounds.*		*Per cent.*	*Pounds.*
Pearl	100	2,890	Turkestan	75	625
Foxtail	90	1,307	German	95	539
Ragi		795	Japanese	65	341
Goldmine	70	710			

Several varieties of cowpeas and soy beans were grown during the season, which confirmed the decision that the best varieties thus far tested for local conditions are the Groit, New Era, and Whippoorwill cowpeas and the Virginia and Arlington soy beans.

Flax.

Flax as a winter crop for seed production, referred to in this station's report for 1914, succeeded very well in 1915, producing good yields, although tested only on small areas. Considerable difference in seed production was observed among the different varieties; also, certain varieties were less resistant to winter frosts than others. As a class the strains introduced from India gave the best results. Further plantings for varietal and cultural tests are being made, in order to determine whether or not this crop may be considered as worthy of a place in the agriculture of this region.

Broom Corn.

Roots of a planting of two varieties of broom corn were maintained through the winter of 1914–15 and allowed to develop an early crop. They were handled in the same manner as the grain-sorghum varieties already described in this report. A nearly perfect stand was secured and the behavior of both varieties was more desirable than that of any of the grain sorghums. The broom-corn brush matured well and more uniformly than from seed plantings.

Green-Manure Crops.

Further figures showing the improvement effected by the addition of a green-manure crop applied to light soil before establishing an alfalfa stand are given in Table IX. This table includes yields that were recorded from fields of this nature, with and without a preceding leguminous green-manure crop.

TABLE IX.—*Yields of alfalfa planted on November 19, 1914, following different green-manure crops on sandy soil, Yuma Experiment Farm, 1915.*

Preceding crop, if any.	Seed per acre for green-manure crop.	Yield of hay per acre in 1915 (tons).	
		Field cured.	Air dry.
	Pounds.		
Tepary beans	44	6.16	5.62
Soy beans	40	5.91	5.40
Groit cowpeas	40	5.84	5.33
Whippoorwill cowpeas	40	5.34	4.87
No previous crop	.....	3.73	3.38

These yields show an increase of approximately 2 tons of air-dry alfalfa hay per acre from land on which a green-manure crop preceded the alfalfa, the average value of which during 1915 amounted to $7.15 per ton, or $14.30 per acre. The total cost of producing and plowing under this crop would not exceed $8.50 per acre, leaving a net profit of $5.80 per acre.

FIG. 2.—Abruzzes rye grown for a green-manure crop on the Yuma Experiment Farm in 1915.

General observations of the behavior of soy beans and cowpeas grown for green-manure crops indicate that the cowpea will endure more intense heat than the soy bean and therefore is a better plant to grow in late summer, while the right varieties of soy beans generally produce a better early crop.

In the maintaining of soil it is often found desirable to give additional humus to a field by growing a green-manure crop in the winter. Such crops that will withstand winter frosts are fewer than those that may be grown during the frost-free season. If the addition of a combination of humus and nitrogen is important, vetches

or field peas should be produced, but if the addition of organic matter is of utmost importance a winter grain may be grown and plowed under during the following April, about the time the grain is flowering. Rye has been found to produce greater amounts of green manure or hay per acre than other small grains. The Italian variety, the Abruzzes, produced during 1915 on light soil 2.66 tons of air-dry hay per acre, while on a heavier loam soil 5 tons were produced. This growth of rye results in the addition of a large quantity of organic matter to the soil, as is shown in figure 2.

IRRIGATION REQUIREMENTS.

Determinations of water requirements for crops grown at this station were made during 1915, as in the two previous years. These figures, along with averages covering the 3-year period, 1913 to 1915, are recorded in Table X, with a notation as to the type of soil under cultivation.

TABLE X.—*Quantities of water applied to different crops on the Yuma Experiment Farm, 1913 to 1915, inclusive.*

Crop.	Use of crop, etc.	Water applied per acre (acre-feet).					
		1915			Average, 1913 to 1915.		
		Light soil.	Medium soil.	Heavy soil.	Light soil.	Medium soil.	Heavy soil.
Alfalfa	Hay	9.11	7.75	4.15	8.24	6.18	[a] 4.15
Do	Seed		4.82		[a] 5.34	4.03	
Cotton	Fiber	7.42	5.26	3.08	6.61	4.32	[a] 3.08
Sorghum (planted in July)	Grain		3.56	2.36	[a] 5.2	3.25	[a] 2.36
Sudan grass	Hay		6.07			[a] 6.36	
Cowpeas	Seed	5.1	3.87		3.83	2.76	
Deciduous fruits	Third year		2.34				
Dates	Seedling nursery		6.33			6.07	
Do	First-year orchard		4.18			[a] 4.18	[a] 3.28
Do	Established orchard		5.23			[a] 4.42	
Figs	do		2.99			[a] 2.98	
Pomegranates	do		3.06			[a] 2.54	

[a] Average for less than three years.

These figures are approximately correct, although the means for measuring water were not entirely satisfactory.

ORCHARD EXPERIMENTS.

DATES.

Among the various seedling date palms growing in orchard positions, a few produced fruit, but not in sufficient quantities to give evidence of their probable quality or value. A great many of the staminate plants have already produced flowers. Plants of varieties of seedlings were transplanted to permanent positions as follows: Tafilet, 358; Menakher, 262; and Thoory, 157. Transplanting was

done in April and early May, with very good results. This season of the year has proved better for transplanting palms than earlier or later. The transplanting of dates should always be postponed until the ground is warm. Seedling date palms now growing on the experiment farm number as follows: In the orchard, 1,096; along roads, 1,317; and in nurseries, 4,330.

DECIDUOUS FRUITS.

A few of the 3-year-old trees in the variety orchard of deciduous fruits produced a first fruit crop this season. Peaches, apricots, and quinces, however, were the only sorts bearing at this age. Among 31 varieties of peaches planted in February, 1913, 7 produced fruit, as shown in Table XI.

TABLE XI.— *Yields of peach varieties producing fruit at 3 years of age, Yuma Experiment Farm, 1915.*

Variety.	Average ripening date.	Number of trees.	Average yield per tree.	Variety.	Average ripening date.	Number of trees.	Average yield per tree.
			Pounds.				*Pounds.*
Honey	July 14	2	20.5	Ceylon	Aug. 14	2	14.0
Mamie Ross	July 26	2	5.0	S. P. I. No. 32379	Aug. 20	1	47.5
S. P. I. No. 32372	July 29	1	7.5	Climax	...do...	2	55.5
Pallas	Aug. 6	2	24.5				

All of these varieties with the exception of the Mamie Ross show a predominance either of south Chinese or Spanish types, which groups of peaches will no doubt be found reliable and profitable bearers in this climate. They are known as varieties best adapted to southern climates. Although tenderness of the fruit limits the possibilities of handling and shipping, they are of excellent flavor and quality for local use. So far as this test is concerned, and this statement is confirmed by all observations of the behavior of the older trees, the more northern varieties of peaches are not regular bearers in this region.

Among the several varieties of apricots bearing fruit at this early age, no important differences were observed and the yields were small. Quinces are notably early bearers in this region. Unless the fruit is thinned from young trees they will often overbear. The foremost variety under test is the Smyrna.

Among certain deciduous fruits—peaches, plums, prunes, apricots, and possibly some others—the annual tree growth in this climate is so great that there seems to be a need for some effective control by pruning. Plantings for experimental pruning will be made in the near future. The rapid growth of deciduous trees of various sorts is shown by Table XII.

TABLE XII.—*Growth of deciduous fruit trees at the Yuma Experiment Farm, 1913 to 1915, inclusive.*

Fruit.	Number of varieties, 1915.	Number of trees, 1915.	Average season's growth.			Average total growth in three seasons.	
			1913	1914	1915	Extreme height.[1]	Trunk diameter.
			Feet.	*Feet.*	*Feet.*	*Feet.*	*Inches.*
Peach	40	83	3.8	6.3	6.54	9.79	3.37
Plum	20	40	3.3	4.9	5.06	7.64	2.2
Prune	8	15	3.2	4.2	5.22	8.72	2.19
Apricot	5	14	3.6	5.3	6.33	9.7	3.07
Nectarine	2	5	3.7	5.3	6.04	9.16	3.06
Cherry	6	10	.....	3.03	4.12	7.64	2.06
Pear	21	63	2.2	3.2	3.93	6.65	1.58
Apple	14	30	2.1	4.2	4.09	7.01	1.81
Quince	4	8	3.2	4.1	4.41	7.54	1.74
Pecan	4	10	.39	.42	1.78	3.49	.98
Walnut	6	8	.35	1.9	4.91	7.95	2.03
Almond	5	9	3.0	4.4	5.09	7.74	2.73
Pistache	11	33	2.9	1.95	2.53	7.38	1.68
Persimmon	13	16	.75	1.3	1.29	2.85	.82

[1] All these trees have been pruned each year as required.

An endeavor to ascertain whether or not maturity of wood through lack of water would increase the frost resistance of young fig trees was attempted, without definite results. All the figs survived uninjured a minimum temperature of 22.5° F., whether watered once or twice during the winter or left dry for three months before the frosts occurred. In the winter of 1914–15, 20 per cent of these trees were frozen to the ground with a minimum temperature of only 25° F.

VEGETABLES.

As shown in former reports from this station, there are numerous vegetables that develop extremely well in the soils and climate of this region, but they have so far been limited in production by difficulties of marketing. Many of these vegetables should be grown for home use, and as marketing methods are perfected no doubt many acres on the Yuma project will be devoted to the production of truck crops. Eight garden crops which will likely be the leaders in such commercial production are briefly discussed here, and such information is given as has been obtained in connection with their culture in the station experimental garden.

ASPARAGUS.

Asparagus may be grown on a variety of soils, but that most desirable is a mellow, rich, sandy loam, easy to cultivate and well fertilized. Unlike most garden crops asparagus is improved by small amounts of white alkali, although the plant should not be expected to thrive in excessively alkaline soils. It grows readily

from seed, and well-grown seedlings are in best condition to transplant when 1 year old. The seed bed should be started in February or March, as the soil then is becoming warm through the day. It is sometimes found advantageous to soak the seed before planting, in order to induce a more rapid germination. The seedlings should be thinned to 3 or 4 inches apart and kept free from weeds.

In preparing the field for transplanting, furrows should be laid off 5 feet apart and the plants set 2 feet apart in the furrow. The plants, or roots, should be planted about 6 inches deep, but not fully covered until top growth begins, when the furrows may be gradually filled by cultivation. Such plantings should be watered frequently until the plants become well established. Asparagus requires and responds to a lavish supply of fertilizers and manures. In order to keep the soil most friable and open, barnyard manure should be applied between the rows each winter and worked into the soil either with a 1-horse plow or a disk harrow before spring growth begins. When more concentrated fertilizers are used, mixtures that are rich in nitrogen and potash should be applied.

The quantity and quality of produce grown depend upon the amount of fertilizers used and cultivation given. Very little asparagus should be cut until the plants are 3 years old, or at least until they have become well established. In this climate, if asparagus is not cut too heavily in the spring and is allowed to stand without much water in late summer it may then be watered and a fall cutting obtained without apparent injury to the plants. Spring cutting can generally begin about February 15. Giant Argenteuil is the best variety that has been found for this region.

CABBAGE.

Cabbage belongs to the cool-weather class of vegetables. It thrives well in winter, but can not endure the heat of summer. Good results may be secured by growing the plants in the open field, but a surer method is to grow the plants in beds and transplant. The seed bed may be prepared by working well-rotted manure with any good garden soil. The seed should be sown broadcast or in drills and covered one-quarter of an inch deep. The surface may be mulched with a layer of fine manure, and the bed must be kept moist until the plants are up. The seedlings should be started in August or September and grown under partial shade. Plants in the seed bed should be thinned while small, bringing about a stocky development. With this practice, seedlings should be ready to transplant to the field by October or early November.

Cabbage grows best in a well-fertilized loam soil. A sandy soil will not produce good heads. Bed culture is generally preferred in

the field, although cabbage may be grown by flat culture. For bed culture, furrows plowed 3½ feet apart and plants set at the water line on each side of the furrow, 18 to 24 inches apart, are properly spaced. When flat culture is practiced it is advisable to set the plants 15 to 20 inches apart in rows 2½ to 3 feet apart. Frequent irrigations are necessary and a cultivation should follow each irrigation to keep the soil in good tilth and prevent weed growth. Early varieties, such as Early Drumhead, All Seasons, Winningstadt, and Henderson's Early, are recommended for planting.

MELONS.

A mellow sandy-loam soil, heavily fertilized with barnyard manure, has been planted to melons at this station for two successive seasons, giving yields of the principal varieties of watermelons as shown in Table XIII.

TABLE XIII.— *Yields of varieties of watermelons in a 2-year test at the Yuma Experiment Farm, 1914 and 1915.*

Variety.	Date first ripe.		Yield per acre (tons).			Average weight per melon (pounds).	
	1914	1915	1914	1915	Average.	1914	1915
Black-Seeded Chilean	June 12	June 15	16.16	20.01	18.09	13.9	13.16
White-Seeded Chilean	June 14	June 14	15.36	26.35	20.85	15.2	13.44
Kleckley Sweet	June 12	June 5	9.51	31.68	20.59	12.1	10.1
Klondike	...do....	June 12	17.82	18.21	18.01	13.9	15.9
Brazilian	June 29	.....	2.75	.....	2.75	11	.....

The preparation of ground for planting melons consists of plowing ridges 8 feet wide, leaving a well-formed furrow between for applying water and affording dry soil for the support of the melon vines. If ridges are laid off east and west, plantings can be made on the south side of a ridge, which affords a warm exposure and promotes the early germination of seed. As the profitableness of melon production in this section is largely dependent on reaching an early market, considerable care is justified in starting the plants early. Seed should generally be planted by January 15. A very successful practice has been that of covering each hill with a small piece of oiled paper, held down by earth, which raises the temperature of the soil and also offers frost protection to the plants while tender. The plants should be thinned to one in the hill as soon as the second leaf is well out. Weeds should be kept down and the soil well cultivated until the vines cover the ground. Frequent irrigations are very essential to the successful production of this crop, although a large quantity of water is not necessary at any application when irrigated in furrows as described.

ONIONS.

It has been demonstrated beyond question, both experimentally and by commercial plantings, that onions on the Yuma project make early and excellent yields. The growth of this industry is dependent only upon an extension of marketing facilities. For onion culture a light, well-fertilized sandy loam will be found most desirable. Onions will not succeed in a soil carrying noticeable quantities of alkali salts, especially when grown on beds.

Onion seed is planted either in field rows or in seedling beds, to be later transplanted to the field, thus allowing the selection of good plants and the discarding of poor ones. The latter method, although followed with unqualified improvement over field plantings in some onion-growing sections, has not given the highest yields of onions in this region. A test at this experiment farm of two varieties grown by both methods gave yields per acre as follows: White Bermuda, sown in the field, 57,222 pounds; transplanted, 29,766 pounds. Crystal Wax, sown in the field, 49,375 pounds; transplanted, 35,733 pounds. A view of a bed of White Bermuda onions is shown in figure 3. All blocks were seeded on October 15, and those from the seed bed were transplanted on January 25, while the harvest of all was made from June 5 to 12. Some result of selection was probably indicated by the fact that the field-grown onions produced many seed stalks, while the transplanted plants produced very few. Other yields in onion tests conducted at this station were discussed in the 1914 report of this station.

Onions grown on a flat may be planted in rows 12 to 15 inches apart if they are to be cultivated by hand tools or 30 inches apart if a horse cultivator is to be used. A very desirable method of planting is on beds, with intervening furrows $3\frac{1}{2}$ feet apart and four rows in a bed. (See fig. 3.)

PEAS.

Peas as a winter garden crop offer a commercial possibility of considerable importance. They may be grown on widely varying soils, although a fertile loam is probably the best. Satisfactory planting dates for peas range from September 1 to February 1. The most desirable method practiced is to plant two rows near the water line on beds 3 to 4 feet broad with intervening furrows for water. Early dwarf varieties planted in September will produce green peas during November. Longer season varieties sown in October will produce good crops in February. Later plantings will bring later crops and the yields generally will be lighter. No doubt, the successful marketing of peas will require a succession of plantings, making the supply continuous for several months. From seven of the best-known commercial varieties of peas planted on October 10, 1914, the variety

American Wonder produced a first picking on February 2, followed by pickings from the following varieties on February 28: Pride of Cahuenga, Yorkshire Hero, Dwarf Telephone, Nott's Excelsior, Premium Gem, and Gradus. The first four varieties produced seven pickings, totaling exceedingly heavy yields.

POTATOES.

Potatoes may be grown with success if the right soil and proper varieties are selected. Only early varieties are dependable and they must be planted in time to assure development before the summer heat begins; otherwise, profitable yields can not be expected. The growing season is normally short, as it is limited by spring frosts and the severe summer heat. Potatoes should be planted during the latter part of January or as soon thereafter as the season will permit. Fall plantings have occasionally given fair returns, but have not yet been demonstrated to be feasible.

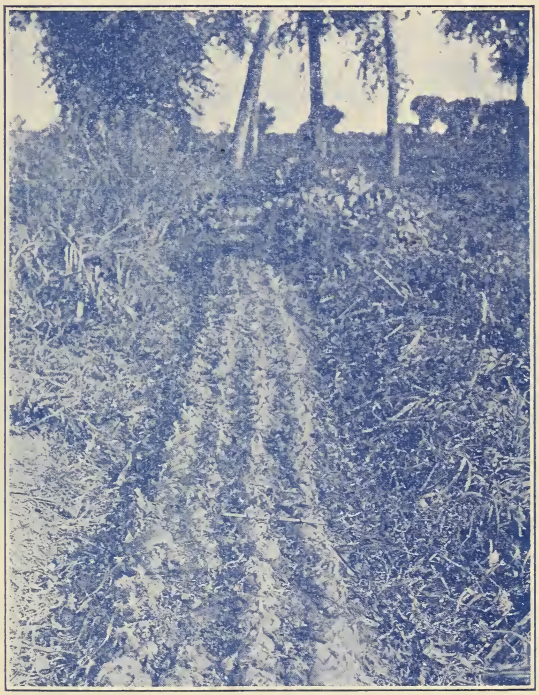

FIG. 3.—A bed of White Bermuda onions growing on the Yuma Experiment Farm in 1915.

A light, rich, well-aerated loam soil, abundantly supplied with humus, should be selected for potatoes. Land that has previously had a crop of alfalfa turned under is generally good. The addition of barnyard manure is always profitable. Heavy soils may be improved by the addition of coarse barnyard manure or straw, which should be applied to the crop of the preceding year. Previous to planting, the field should be heavily irrigated and plowed deep as soon as dry enough. It should be laid off immediately in rows 3½ feet apart and the potatoes dropped 12 inches apart in the row and covered 4 inches deep. The field should then be harrowed level, and at all times, as the crop develops, should be kept well cultivated and free from weeds. As long as the earth remains moist, no further

irrigations are necessary, but the soil should not be allowed to become hard and dry. At this season of the year, when temperatures and evaporation are not high, a potato crop may be produced with a small quantity of water. Too much water causes the growth of a large vine and few potatoes. As soon as the tubers are grown the water should be withheld, to induce ripening. It is desirable to apply irrigations by furrows between the rows, thus keeping the water from the plants.

In Table XIV are shown the yields and dates of maturity of potatoes grown in a varietal test on the experiment farm in the spring of 1915.

TABLE XIV.— *Yields in a variety test of potatoes planted at the Yuma Experiment Farm on January 28, 1915.*

Variety.	Date matured.	Percentage of unmarketable potatoes.	Yields per acre (bushels).	
			Gross.	Marketable.
Irish Cobbler	May 28	14.08	143.8	123.5
Quick Lunch	May 21	22.75	125.7	97.3
Early Ohio	June 3	20.81	112.5	89.0
Triumph	June 9	26.89	85.8	62.7
Harvest King	June 11	44.3	98.1	54.6

Other qualities of the Irish Cobbler variety commend it for this region as highly as its superior production. When stored along with the varieties shown in Table XIV, it proved to be the best summer keeper. Inasmuch as it is very difficult to store potatoes in this climate, the production of a few fall potatoes may partially solve the problem of seed for the following season. It has commonly been found difficult to secure eastern or northern seed during January, owing to danger of freezing while in transit.

SWEET POTATOES.

Large areas of land on the Yuma project are suitable for sweet-potato production. While this fact is generally realized, there is at present no extensive production of this crop, owing to the difficulty of selling it. Several varieties well adapted to this region are known, but perhaps none is better than the White Vineless. In 1915, 10.3 tons per acre were produced from plantings of this variety made on April 21. The potatoes were mature on November 1. (See fig. 4.)

A rich, sandy soil is the most suitable for the sweet potato. The ground should be prepared by plowing ridges 3½ feet apart and the plants set in rows on one side of the ridge at spaces 15 inches apart in the rows. When the plants are well established and the runners start, the soil should be worked to the plants on the furrow side of the row by plowing from the side of the adjoining ridge, thus leaving all rows in the center of the ridges. The sweet potato is somewhat drought resistant, but responds directly to ample irrigation. A large

crop is produced and the potatoes develop nearer the surface of the ground when well watered. Until the furrows are covered with vines the young plants should be watered every 7 to 10 days, followed by cultivation. Frequent and light irrigations are more desirable than heavy irrigations at longer intervals.

TOMATOES.

Few vegetables are more highly relished during the hot season than tomatoes. While the tomato is more exacting in its requirements than most vegetables, it can be grown successfully with proper care. Tomatoes are usually started in hotbeds or covered coldframes, the seed being sown about the first of January. When the seedlings are 2 to 3 inches high they should be transplanted to pots or to another bed until large enough to be taken to the field after the danger of frost is past. Plants should be set in the garden at 4-foot spaces on beds

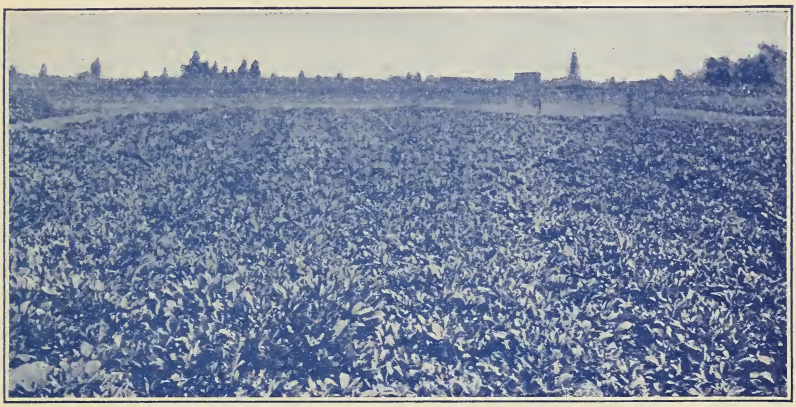

FIG. 4.—White vineless sweet potatoes grown on the Yuma Experiment Farm in 1915.

6 feet apart for tall varieties or at 3-foot spaces on beds $3\frac{1}{2}$ feet apart for dwarf varieties. The seed may, however, be sown during February in the open ground and later thinned to one plant in a hill.

The tomato will thrive on various types of soil, though light silt or loam is best. An exceedingly heavy soil induces excessive plant growth and less fruit, while a sandy soil produces small plants and light yields. Sufficient irrigations should be given to produce a steady growth. Excessive irrigation often results in a large vine and little fruit and is sometimes the cause of fruit not setting. Flowers opening during extremely hot weather are likely to be shed. Early-planted tomatoes begin to ripen about June 1, continuing through July. Varieties adapted to conditions on the project were discussed in the report of this station for 1914, but two other varieties, the Dwarf Champion and Dwarf Stone, may also be recommended. Dwarf varieties are preferable, as they produce abundant foliage to protect the fruit from sunburn.

ORNAMENTAL PLANTS.

At the end of the third year following the planting of various species and varieties of ornamental trees and shrubs on the experiment-farm grounds, certain information has been collected that seems to justify the recommendation of a few plants as being especially well adapted for street and ground plantings in this locality.

In a climate of such mild winters the greatest value will always be attached to plants that hold their foliage throughout the year. Among the evergreen trees tested the following may be recommended most highly: Desert gum (*Eucalyptus rudis*), red gum (*Eucalyptus rostrata*), pepper (*Schinus molle*), Arizona cypress (*Cupressus arizonica*), Monterey cypress (*Cupressus macrocarpa*), Italian cypress (*Cupressus sempervirens*), and beefwood (*Casuarina stricta*).

Perhaps no class of trees after a few years' growth will afford more satisfaction and beauty than the palms. Those known to succeed well here are the following: Fan palms (*Washingtonia filifera* and *Washingtonia robusta*), the ornamental date palm (*Phoenix canariensis*), the blue palm (*Erythea armata*), and the true date palm (*Phoenix dactylifera*). Besides these, several species that are now being tested seem very promising in their early stages.

Although ornamental deciduous trees afford shade for only 8 to 8½ months of the year, certain species are valuable because of their rapid early growth and their endurance of the hardships and neglect to which ornamental trees are so often subjected. Among these trees the native willow and cottonwood should first be thought of, as the supply for planting is so abundant on the bottom lands of the Colorado River. When permanent plantings are made, evergreens will generally supplant these trees, but for the early settler much shade and comfort is provided where he at once establishes plantings of these native trees. Figure 5 shows a planting of native cottonwoods which are 5 years old. These trees came from straight cottonwood poles 14 feet long, cut while dormant and immediately set in deep holes extending to ground water. The growth following was rapid, and some shade was provided the second year. This is a very convenient method of propagation.

Unlike many trees, both cottonwoods and willows are dicœcious, there being both male and female trees. When cuttings are being made for propagation by this method care should be taken to select limbs from staminate trees, so that seed will not be produced to drift about in the wind. Such a precaution will overcome the most objectionable feature of these trees. The desirable male trees from which propagations are to be made produce no cottony seed and may be recognized and marked during the flowering season. Various other species of willows and cottonwoods are being tested on the experiment-farm

grounds, but are yet too small to permit a determination of their value.

Of the native deciduous trees there are only four others of importance, namely, mesquite, screw bean, palo verde, and ironwood, all of which are of slow growth and difficult to transplant except as very small seedlings. Ornamental specimens of these generally occur only where in clearing it has been found convenient to leave a tree near the road or on the building grounds.

Other deciduous trees that are valuable for their shade and rapid growth are the Texas umbrella (*Melia azedarach*), Arizona ash (*Fraxinus velutina*), Chinese elm (*Ulmus pumila*), and varieties of at least two species of mulberry (*Morus alba* and *M. rubra*).

FIG. 5.—Cottonwood trees grown from poles. Yuma Reclamation Project, 1915.

A few evergreen shrubs that have already proved their value for planting in this climate are as follows: *Escallonia alba*, Carolina cherry laurel (*Prunus caroliniana*), loquat (*Eriobotrya japonica*), and oleander (*Nerium lauriforme*). The oleander with either pink or white flowers is a profuse bloomer over a long season and of very rapid growth. Perhaps the most pleasing of all evergreen shrubs in this climate are everblooming roses. The varieties which follow have all succeeded well on the experiment-farm grounds: Red—Gruss an Teplitz, Richmond, Helen Gould, and Agrippina. Pink—Madam Abel Chatenay, La Detroit, Mrs. John Lang, Madam Caroline Testout, Antoine Revoire, Duchess of Albany, and La France. White—Kaiserin. Yellow—Lady Hillingdon, Sunburst, and Perle des Jardins.

Bridal wreath (*Spirea van houttei*) and crape myrtle (*Lagerstroemia indica*) are deciduous flowering shrubs that are very satisfactory here. The latter produces many flowers throughout the intense heat of the summer, when flowers are few.

Climbing roses are as superior among perennial trailers adapted to this region as everblooming bush roses among other shrubs. In this class of roses also the everbloomers are most desirable, and among them are found the varieties that hold their foliage best

FIG. 6.—A 2-year-old plant of the Marechal Niel climbing rose. Yuma Experiment Farm, 1915.

throughout the winter. The most evergreen variety tested is the Marechal Niel (fig. 6), which holds its glossy waxlike leaves through the winter, even after considerable frost. Many climbers make the most vigorous growth when grafted on a rapid-growing root.

The following climbing roses, grouped according to colors and in the order of their degree of success, are those recommended for planting under local conditions: Yellow—Marechal Niel (see fig. 6), Duchess de Auerstadt, Perle des Jardins. White—Kaiserin. Pink—Madam Caroline Testout. Red—Reine Marie Henriette. Other

climbing roses of promise but not everbloomers are the Crimson Rambler, red; Dorothy Perkins, pink; and the Chinese rose (S. P. I. No. 23035), white. In figure 7 is shown a screen of Chinese roses (S. P. I. No. 23035) growing on the south living porch of a house on the experiment farm.

Other well-adapted perennial climbers are the wistaria (*Wisteria chinensis* and *W. multijugæa*) and the kudzu vine (*Pueraria thunbergiana*). The bougainvillea, while succeeding well on the mesa lands of the Yuma project, does not withstand the minimum temperatures of the valley lands.

FIG. 7.—Chinese roses (S. P. I. No. 23035). Yuma Experiment Farm, 1915.

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